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Dynamic Modeling of Pectin Extraction for Monitoring and Optimisation

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Introduction

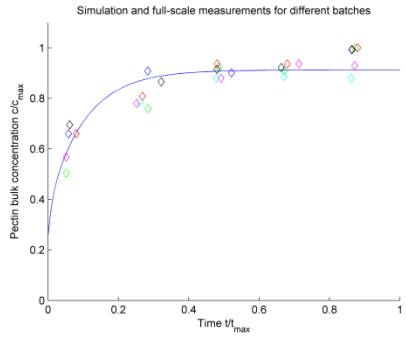
Pectin is used as an additive in many food and pharmaceutical products to modify the rheological properties of the product [1]. Commercial pectin extraction is a batch operation with several tanks that can feed continuously the downstream processing.

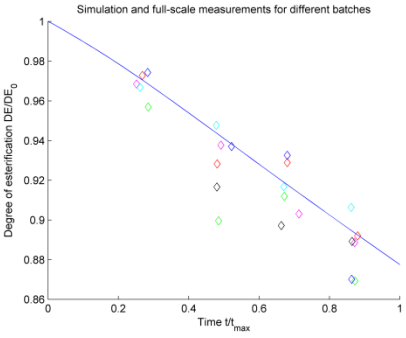
The variability of the raw material is a continuous input of uncontrolled disturbances to the process. Consequently, the process conditions should be constantly adjusted in order to obtain a high pectin yield and good product quality. The pectin quality can be characterized by the degree of esterification (%DE) [2].

Measurements of %DE can only be carried out after precipitation, which occurs several hours from the start of extraction. As a consequence, some batches are processed under non-optimal conditions reducing pectin yield and quality.

Results

The mathematical model of pectin bulk concentration and DE is validated with full-scale measurements for constant temperature and pH as shown in the figures.

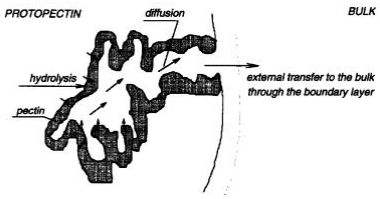




Model

Pectin is dispersed in the peel as protopectin and is leached by acid hydrolysis as shown in the figure modified from [1]. The mechanisms covered by the model are:

- Acidic hydrolysis of protopectin
- Diffusion of pectin inside the peel
- Mass transport of pectin through the boundary layer to the bulk
- De-esterification of pectin in the bulk



A system of differential equation can be set up that decribes the concentrations of pectin inside the peel, protopectin and pectin in the bulk.

Current Status and Outlook

A mathematical model has been developed that is able to forecast the pectin bulk concentration and DE in full-scale for constant temperature and pH.

In pilot scale the effects of temperature and pH on the reaction kinetics will be studied and incorporated in the model.

References:
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